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REPORT
FOUNDATION INVESTIGATION
PROPOSED MALIA TERRACE
DEVELOPMENT

KANEOHE, OAHU,
STATE OF HAWAII

550

for

MALIA ENTERPRISES

WATSON LEE, INCORPORATED
Civil Engineers

August 20, 1973
Project No. 194-001-01

MAURSETH, HOWE, LOCKWOOD & ASSOCIATES
Consulting Foundation Engineers & Geologists

WITHDRAWN

The Malia Terrace Subdivision

Erosion Control Procedures

1. The entire area will be cleared and grubbed to allow work on the lot grading to begin. This lot grading is a major portion of the work. Watering of the cleared areas will keep dust pollution to a minimum.
2. Silting basins in the area of lots 3-A and 4-A will be dug to ~~for~~ sediments to settle before reaching the existing CRM ditch. The existing topography lends itself to this natural location. The high banks and slope channel runoff water towards these basins.
3. Lots 8 thru 21 will be cut to grade and excess fill materials will be used to build up the lower areas in lots 1 thru 7, and 1-A thru 6-A.
4. The hollow tile walls will be constructed as soon as feasible to minimize the chance of bank erosion.
5. Once house pads have reached final grade, berms will be placed at the lowest points to temporarily pond water runoff.
6. Drainlines and drainmanholes and catch basins will be protected from silt collection with filtering materials at the inlets. As these structures become completed, further erosion and sedimentation will decrease.
7. We will do all we can to prevent any foreseeable dust, erosion, or sedimentation problems that may arise as the job progresses.

Prepared by: Highway Construction Co., Ltd.

NOV 27 1973
GRADING PERMIT NO. 6210

Approved:

[Signature]
Director & Chief Engineer DAW

11/26/73
Date

[Signature]
Chief Division of Engineering

11/21/73
Date

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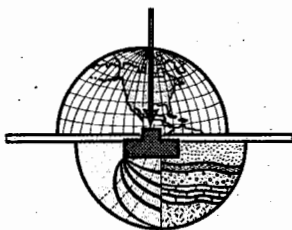
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Honolulu, Hawaii

August 20, 1973

Job No. 194-001-01

Malia Enterprises
926 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Watson Lee

Gentlemen:

The attached report presents the data, conclusions and recommendations of an investigation of the subsurface conditions at the site of the proposed residences to be constructed at Kaneohe, Oahu, State of Hawaii.

The details and scope of this investigation were discussed with Mr. Watson Lee of Watson Lee, Incorporated.

Based on the findings of this investigation, it is concluded that the site can be developed for the intended use. A slab-on-grade, with thickened edges may be used for the support of the woodframe residences.

This investigation was made in accordance with generally accepted engineering procedures and included such field and laboratory tests considered necessary in the circumstances. In the opinion of the undersigned, the accompanying report has been substantiated by mathematical data in conformity with generally accepted engineering principles and presents fairly the design information requested by your organization.

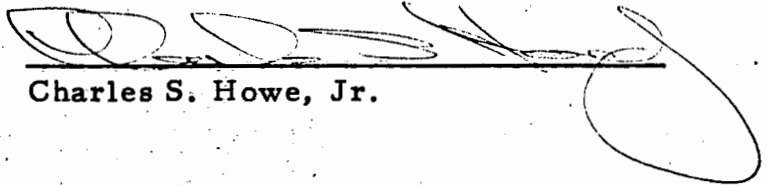
This investigation was performed under the supervision of the undersigned.



CSH/rlk

Very truly yours,

MAURSETH, HOWE, LOCKWOOD
& ASSOCIATES



Charles S. Howe, Jr.

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INTRODUCTION

This investigation was made for the purpose of obtaining information on the subsurface soils on which to base recommendations for foundation design for the proposed residences to be located at Kaneohe, Oahu, State of Hawaii. The general site location is shown on the Vicinity Map, Platel, attached to this report.

SCOPE OF WORK

The foundation investigation was discussed with Mr. Watson Lee. Basically, the following information is provided for use by the Architects and Engineers:

1. General soil conditions of the site.
2. The physical characteristics of the soils encountered.
3. Recommendations regarding the most suitable type or types of foundations for the proposed structure.
4. Recommended allowable bearing pressures.
5. Estimated settlements of foundations subjected to design pressures.
6. Recommended values for available resistance to lateral loads for the recommended types of foundations and retaining walls.
7. Opinions on possible construction problems.

PROPOSED DEVELOPMENT

It is understood that the site will be developed for twenty-five, single family, residential units. Grading will consist of cutting the high knoll to

the southeast up to six feet, then placing the excavated materials, as compacted fill, in the lower easterly portion of the property. There will be several retaining walls, with a maximum height of six feet, in the area of lots 11 through 21 and a three foot high wall designated as Wall "A" along the property line of lot 5.

SITE CONDITIONS

Surface

The site is presently a vacant parcel, ranging in elevation from +4 along the easterly property line to an elevation of +48 in the southwesterly portion of the parcel. The higher portion of the property is covered with trees, while the lower elevations are covered with a dense growth of buffalo grass.

Subsurface

The subsurface conditions at the site were explored to obtain engineering data by means of eleven (11) test pits, excavated with a backhoe to depths ranging from 4 to 13 feet. Detailed logs of the test pits and the test results are presented in Appendix A. The location of the test pits are shown on the Plot Plan, Plate 2, attached to this report.

The soils encountered in the higher portion, represented by Test Pit No. 1 through 4 and No. 10, consisted of firm, silty, sandy clays. The area at the base of the knoll, designated Area "B", was explored by Test

Pits No. 5, 8 and 11 and is comprised of firm to moderately firm silts and clays underlain by highly weathered basalt. Test Pit No. 8 encountered moderately soft silt below three feet. The lower area, designated Area "A", and shown on the Plot Plan as a soft area, consisted generally, of very soft clays, underlain by highly weathered, fractured basalt at depths ranging from 4.5 feet to 7.5 below the existing surface.

Filled ground was encountered in both Test Pits No. 5 and 6 to a depth of three feet. The fill in both test pits contained debris.

In the lower area ground water was encountered at depths ranging from 5.0 to 12.5 feet.

CONCLUSIONS AND RECOMMENDATIONS

General

Based upon the findings and observations, it is concluded that a slab-on-grade with thickened edges will offer adequate support for the structures. Within the moderately soft, and soft areas designated on the Plot Plan, it is estimated that the proposed fills will cause areal settlements varying from two (2) to four (4) inches.

Provisions should be made to protect the foundation soils from moisture infiltration. It is recommended that exterior grading provide for adequate drainage away from the structures.

Site Preparation And Grading

It is recommended that the site be prepared in accordance with the "Specifications For Controlled Earthwork" as contained in Appendix B.

Foundations

Firm Area: "C"

A reinforced concrete slab with thickened edges may be designed for an allowable bearing pressure of 2,000 pounds per square foot. This bearing value applies for footings founded on natural soils or on compacted fills, and is also applicable to the proposed retaining wall footing in this area.

Moderately Soft And Soft Areas: "B" and "A"

A reinforced concrete slab with thickened edges may be designed for an allowable bearing pressure of 1,000 pounds per square foot. This bearing value applies to footings founded on at least three (3) feet of compacted soil. The slab and foundations for residences and utility lines in this area should be designed to accommodate anticipated areal settlements caused by the weight of the fill.

Total settlements are estimated to vary from two (2) to four (4) inches. If the proposed compacted fills are in place six months prior to developing these areas, 40 percent of the anticipated settlements should have occurred. It is recommended that the settlement be monitored

with level readings periodically made from three or four settlement platforms. These platforms should be founded eighteen inches below the original ground surface prior to placing any fill.

The three foot high retaining wall, designated as Wall "A", may be designed for an allowable bearing pressure of 1,000 pounds per square foot, providing it is supported by a minimum of three (3) feet of compacted soil or crushed rock. The supporting compacted soil or crushed rock shall extend from the heel of the wall footing to a point three (3) feet beyond the toe.

The bearing values presented in this report are net bearing values and the weight of the concrete foundations, below the lowest adjacent final grade, may be ignored in determining the foundation loads. The bearing value may be increased by thirty-three (33) percent for momentary loads due to wind or earthquake. If any foundation is eccentrically loaded, the maximum edge pressure shall not exceed the bearing pressure for permanent or for momentary loads.

Lateral Loads

Lateral loads, such as wind, seismic forces or active earth pressures behind retaining walls, may be resisted by friction between the footings and foundation soils and the resistance can be assumed to be equal to 0.4 times the dead load.

Retaining Walls

Retaining walls with drained, level backfill may be designed to resist an active lateral pressure equivalent to that exerted by a fluid weighing thirty (30) pounds per cubic foot.

Slopes

Fill and cut slopes of 2 : 1 (horizontal to vertical), are recommended to a maximum height of fifteen (15) feet. Preparation of the site prior to construction of fills shall be as described in the "Specification For Controlled Earthwork", Appendix B. Buildings or structures shall be placed no closer than five (5) feet from the crest of a slope or a distance equal to the slope height, whichever is greater.

INSPECTION

During the process of construction, so as to achieve the desired results, it is recommended that the Soils Engineer be present to inspect the following operations:

1. Site Preparation
2. Placement of Fill and Backfill
3. Inspection of Footing Excavations

REMARKS

Areas between and beyond explorations are assumed to be consistent with those sampled and tested. While no major changes in strata depths

or thicknesses are anticipated, it should be realized that the depths to the various soil and/or rock layers will vary over the site, as indicated by the findings.

This report has been compiled for the exclusive use of Malia Enterprises. It shall not be transferred to or used by a third party or to another project without consent and/or thorough review by this facility.

Should the project be delayed beyond the period of one year from the date of this report, the report shall be reviewed to consider possible changed conditions.

Samples obtained in this investigation will deteriorate with time and will be unsuitable for further laboratory testing within one month from the date of this report. Unless advised otherwise, the samples will be discarded at that time.

- o o o -

The following are included and complete this report:

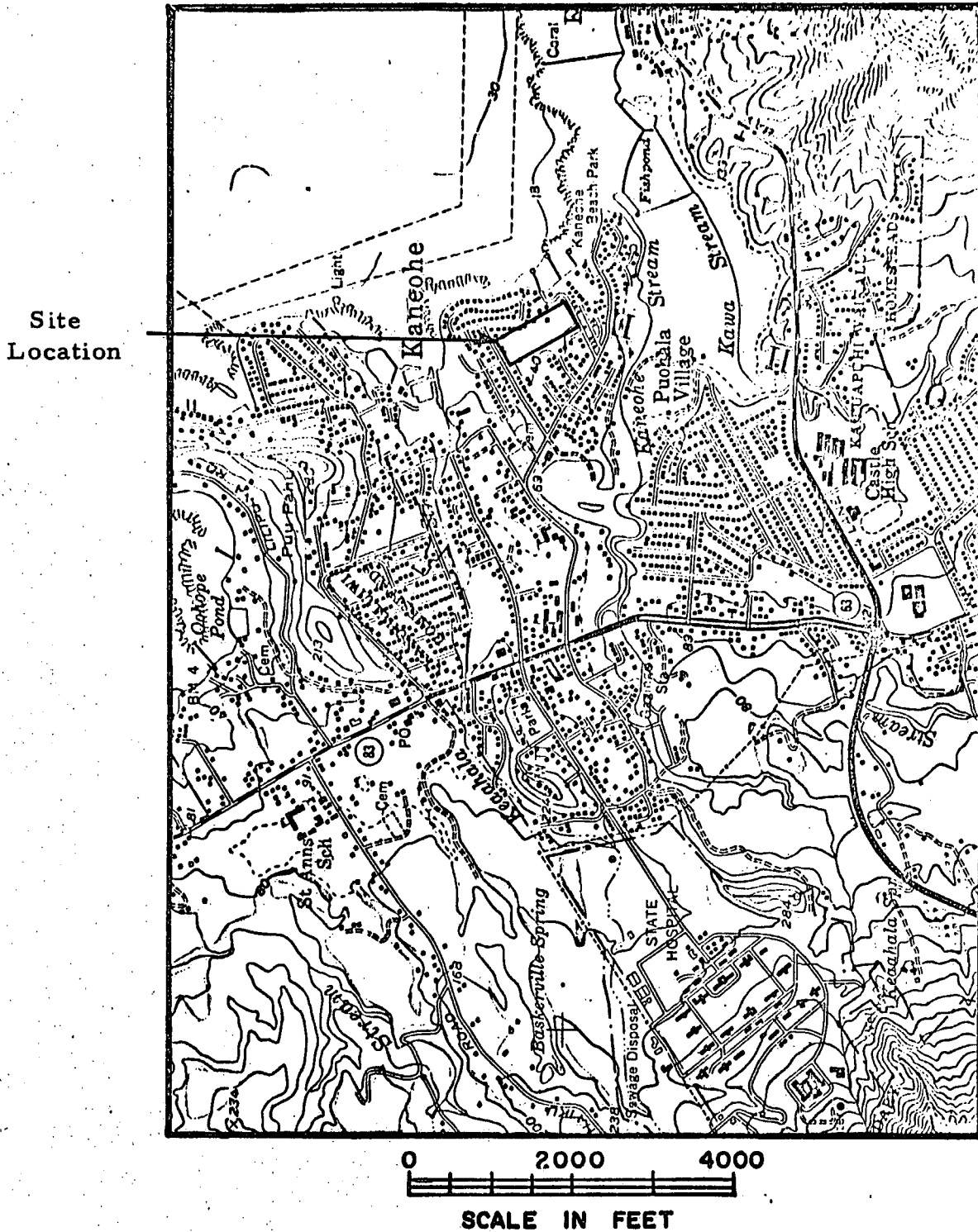
Plate 1 - Vicinity Map

Plate 2 - Plot Plan

Appendix A - Field Investigation and Laboratory Testing

Appendix B - Specification For Controlled Earthwork

VICINITY MAP



REFERENCE

USGS Topographic Survey
Kaneohe, Oahu Quadrangle
Dated 1959

MALIA TERRACE

MAURSETH HOWE LOCKWOOD & ASSOC.

PLATE NO 1

FILE NO 194-001-01

APPENDIX A

FIELD INVESTIGATION AND LABORATORY TESTING

FIELD INVESTIGATION AND

LABORATORY TESTING

Field Investigation

The subsurface conditions of the site were explored by excavating eleven (11) backhoe pits to depths of from 4.0 to 13.0 feet. The location of these test pits is shown on the Plot Plan, Plate 2. Detailed logs of the soils and rock encountered are presented on Plates 3 through 13.

Relatively undisturbed samples were obtained by driving a sampling tube into the underlying soils at various intervals below the surface by means of a heavy driving weight. The sampling tube consists of a steel barrel, 2.50 inches inside diameter, with an interior lining of one (1) inch long, thin brass rings. The sampling tube is driven approximately eighteen inches into the soil and a section of the central portion of the sample is taken to the laboratory in a closely fitted, waterproof container in order to retain the field moisture until completion of the tests.

Laboratory Testing

Samples were selected for laboratory testing following a review of the field investigation. Tests performed included unit weight and moisture content, direct shear tests, expansion and consolidation tests.

Moisture Density Tests

The in-place moisture content and density tests of samples obtained were made to correlate between similar samples. One or more one (1)

inch long sections of the sample are cut, trimmed, weighed, oven dried and reweighed. From these measurements, the unit weight of the solids in pounds per cubic foot and the percent of moisture are calculated. The test results are presented on the Log of Test Pits, Plates 3 through 13.

Direct Shear Tests

To determine the strength characteristics of the soils encountered, direct shear tests were performed. Shear tests were performed on undisturbed samples in their natural moisture content. Each sample is sheared under a normal load approximately equivalent to the existing overburden pressure. The axial load is transmitted to the end of the sample through porous disks, which allow the sample to drain during loading. The results of these tests are presented on the Log of Test Pits, Plates 3 through 13.

Expansion Test

To determine the expansive characteristics of the soil encountered, an expansion test was performed on a representative sample of the firm clay taken from Test Pit No. 3. The sample was air dried, then saturated under a confining pressure of 144 pounds per square foot. The results of this test showed zero expansion.

Consolidation Tests

Two consolidation tests were performed on representative, near surface samples. The tests were performed under a saturated condition,

on a one (1) inch high sample. Incremental loads are applied to the faces of the sample, and the deflection is measured to 1/10,000 of an inch.

Drainage of the samples during consolidation was through the porous disks that are placed against each face of the sample. From the data collected, settlements under the anticipated loads could be calculated. The test results are presented on Plates 14 and 15.

LOG OF TEST PIT NO 1

DATE July 23, 1973
EQUIPMENT USED Backhoe

ELEV OF SURFACE 45.0'±

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE	DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
.40	2.14	67	37.7			2	CLAY, silty, sandy (CL)	brown	moist	firm
						4	less sand	orange brown & blue grey		
						6	End of Test Pit @ 5.0' No Water Encountered			

Ref. Elev. from Grading Plan by Watson Lee, Inc., Civil Engineer, Undated

MALLA TERRACE

PLATE NO 3

MAURSETH HOWE LOCKWOOD & ASSOC.

FILE NO 194-001-01

LOG OF TEST PIT NO 2

DATE July 23, 1973
EQUIPMENT USED Backhoe

ELEV OF SURFACE 39.0'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
.25	1.64	68	41.4		2	CLAY, silty, some sand (CL)	orange brown	moist	firm
					4		orange brown & blue grey		
					6	End of Test Pit @ 5.0' No Water Encountered			

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PLATE NO 4

MAURSETH HOWE LOCKWOOD & ASSOC.

FILE NO 194-001-01

LOG OF TEST PIT NO 3

DATE July 23, 1973

EQUIPMENT USED Backhoe

ELEV OF SURFACE 41.5'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
.40	.94	64	34.2		2	CLAY, silty sandy (CL)	orange brown	moist	firm
					4				
					6	End of Test Pit @ 5.0' No Water Encountered			

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MAURSETH HOWE LOCKWOOD & ASSOC.

PLATE NO 5

FILE NO 194-001-01

4

EQUIPMENT USED Backhoe

ELEV OF SURFACE 28.0'

OF

FILE NO 194-001-01

LOG OF TEST PIT NO 5


DATE July 23, 1973

EQUIPMENT USED Backhoe

ELEV OF SURFACE

7.1'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
						FILL CLAY, silty, sandy, some debris (CL)	red brown	moist	firm
					-2-				
					-4-	CLAY, silty (CH)	blue grey	very moist	mod. firm
					-6-				
					-8-	BASALT, highly weathered			hard
					-10-				
					-12-				
						End of Test Pit @ 13.0' Water Encountered @ 8.5'			

MALIA TERRACE

MAURSETH HOWE LOCKWOOD & ASSOC.

PLATE NO 7

FILE NO 194-001-01

LOG OF TEST PIT NO 6

DATE July 23, 1973

EQUIPMENT USED Backhoe

ELEV OF SURFACE 4.2'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
						FILL CLAY, silty, sandy, some debris (CL)	red brown	moist	firm
.40	.32	52	71.9		2				
					4	CLAY, silty (CH)	grey blue	very moist	soft
					6				
					8	BASALT, highly weathered	grey		hard
					10				
					12				
					14	End of Test Pit @ 13.0' Water Encountered @ 7.0'			

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PLATE NO 8

FILE NO 194-001-01

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EQUIPMENT USED Backhoe

4.0'

OF

FILE NO 194-001-01

LOG OF TEST PIT NO

8

DATE July 23, 1973

EQUIPMENT USED Backhoe

ELEV OF SURFACE 7.0'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
						CLAY, silty (CH)	orange brown	moist	mod. firm
.20	.82	61	51.9		2				
					4				
					6		blue grey		soft
.60	.89	66	66.9		8				
					10				
					12				
					14	End of Test Pit @ 13.0' Water Encountered @ 12.5'			

MALIA TERRACE

PLATE NO 10

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FILE NO 194-001-01

LOG OF TEST PIT NO


9

DATE July 23, 1973

EQUIPMENT USED Backhoe

ELEV OF SURFACE 4.5'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
						CLAY, silty, sandy (CL)	brown	moist	mod. firm
					2				
					4	SILT, organic (OL)	dark grey	very moist	mod soft
			146.7		6	BASALT, highly weathered			hard
					8	End of Test Pit @ 7.0' Water Encountered @ 5.5'			
MALIA TERRACE							PLATE NO 11		
MAURSETH HOWE LOCKWOOD & ASSOC.							FILE NO 194-001-01		

LOG OF TEST PIT NO

10

DATE July 23, 1973
EQUIPMENT USED Backhoe

ELEV OF SURFACE 6.8'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
			44.6		2 4 6	CLAY, silty, sandy (CL)	red	moist	firm
						End of Test Pit @ 6.0' No Water Encountered			

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PLATE NO 12

MAURSETH HOWE LOCKWOOD & ASSOC.

FILE NO 194-001-01

LOG OF TEST PIT NO 11

DATE July 23, 1973
EQUIPMENT USED Backhoe

ELEV OF SURFACE 4.2'

DESCRIPTION OF SOILS

CONFINING PRESSURE kips/sq ft	SHEAR STRENGTH kips/sq ft	DRY DENSITY lbs per cu ft	PERCENT MOISTURE	BLOWS PER FOOT	SAMPLE DEPTH IN FEET	CLASSIFICATION	COLOR	MOISTURE	CONSISTENCY
		53	99.8		2	CLAY, silty (CL)	light brown	very moist	mod firm
					4				
					6	BASALT, highly weathered	grey brown		hard
						End of Test Pit @ 6.0' No Water Encountered			

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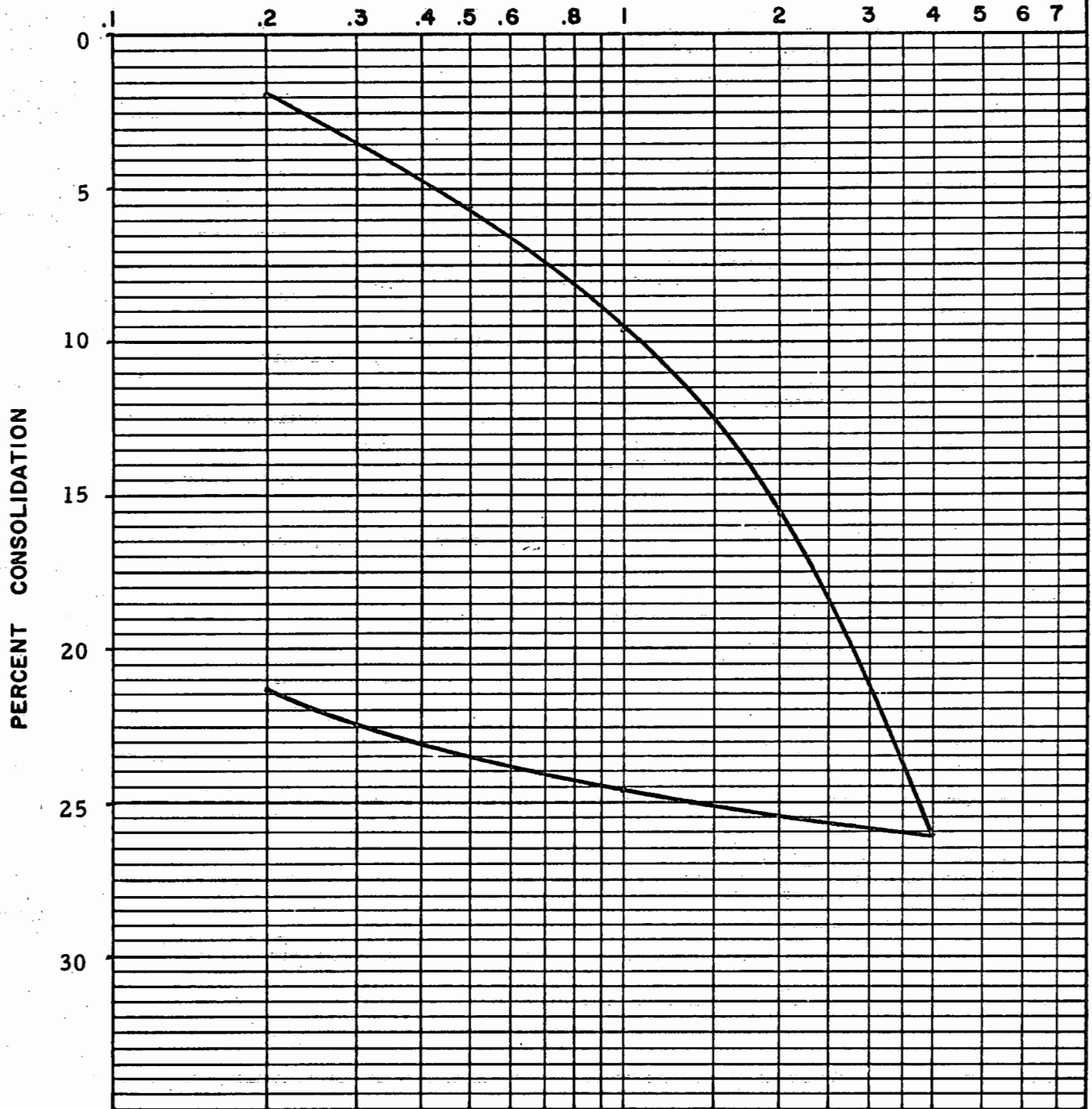
MAURSETH HOWE LOCKWOOD & ASSOC.

PLATE NO 13

FILE NO 194-00.1-01

CONSOLIDATION TEST DATA

PRESSURE IN KIPS PER SQUARE FOOT



Test Pit No. 6, Sample No. 1 @ 4.0'

MALIA TERRACE

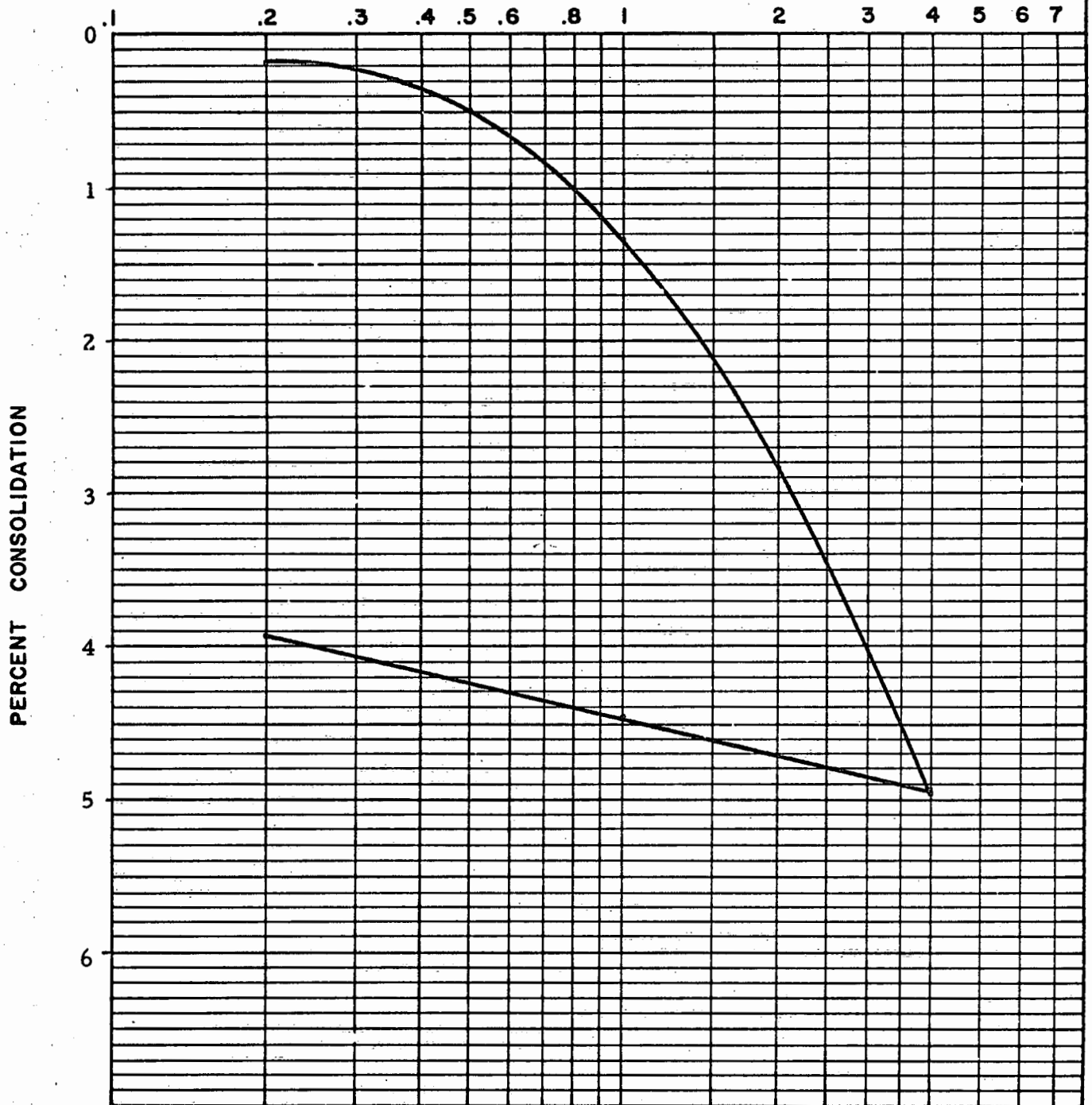
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PLATE NO 14

FILE NO 194-001-01

CONSOLIDATION TEST DATA

PRESSURE IN KIPS PER SQUARE FOOT



Test Pit No. 8, Sample No. 2 @ 6.0'

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MAURSETH HOWE LOCKWOOD & ASSOC.

PLATE NO 15

FILE NO 194-001-01

APPENDIX B

SPECIFICATION FOR CONTROLLED EARTHWORK

SPECIFICATION FOR CONTROLLED EARTHWORK

General

The designation "Controlled Earthwork" is applied to cuts and fills constructed and inspected by a Soils Engineer (a registered Civil Engineer), who shall approve all foundation preparation, fill material, methods of placing and compaction, and perform field density tests and inspection during grading. Written approval shall be issued upon completion of cuts and fills. No deviation from these specifications shall be made except upon the written approval of the Soils Engineer, or other public agencies having jurisdiction.

Clearing and Grubbing

All timber, logs, trees, brush, roots, grass, buried rubbish, decayed matter, existing fill or other deleterious material within the areas affected by the grading, shall be removed or otherwise disposed of in a satisfactory manner.

Foundation Preparation

Areas upon which fill is to be placed shall be uniformly scarified to a depth of at least six (6) inches until free of large clods, brought to the proper moisture content and compacted until the density meets the requirements as hereinafter specified. All loose material shall be first removed.

Loose material to be considered on this project includes existing fill and soil disturbed by the clearing and grubbing operations. The loose

material may be reused as fill, provided that it meets the requirements for fill material specified herein.

Fill Material

When the material to be used as fill contains large rocks or hard, cemented lumps that cannot be broken readily, such material shall be placed in open, non-structural fill areas or removed from the site. If placed in open areas, the boulders shall be well distributed throughout the fill and surrounded by sufficient fine soils so as to fill the interstices, and produce a dense fill without voids. No rocks over three (3) inches in greatest diameter shall be used in the upper one (1) foot of fill. All large boulders, which cannot be broken down to a maximum diameter of six (6) inches, shall be removed or stockpiled for use other than as an engineered fill. Jetting will not be permitted. All material to be used as fill shall be approved for that purpose by the Soils Engineer. No soils shall be imported to the site without prior approval by the Soils Engineer.

Compaction Requirements

All fill shall be placed in uniform layers not exceeding eight (8) inches in loose thickness. Each layer shall be thoroughly compacted completely to the edges before the next layer is laid thereon. Compaction shall be obtained with the use of conventional equipment designed for the purpose. The incidental compaction achieved by the passage of hauling units over the fill shall not be considered adequate.

Each layer of soil shall be brought to a moisture content sufficiently close to "optimum moisture" to permit the required degree of compaction. The "optimum moisture" being determined by the ASTM D - 1557 Compaction Test Method. If the soil's moisture content is too high or too low, it shall be adjusted by suitable means before placing. Compaction of each layer of fill including slopes, berms, etc., shall be continued until the density, as determined by field tests, reaches a value of at least ninety (90) percent of the maximum indicated by the aforementioned methods. In lieu of compacting the slopes, the embankment may be overfilled and then cut back to adequately compacted material.

In all cases where the ground slope is steeper than five (5) horizontal to one (1) vertical, the existing ground shall be benched as the fill thereon is brought up in layers. Provided, however, that existing ground slopes flatter than five (5) to one (1) shall be benched also if the Soils Engineer considers such to be necessary.

Cuts

All cuts shall be made to the lines and grades as shown on the project plans. All cuts shall be inspected and approved by the Soils Engineer. Where conditions encountered require, he shall direct the necessary modifications be made.

Drainage

Care shall be exercised during rough grading so that areas involved will drain properly. Water shall be prevented from running over slopes by temporary berms.

Field Testing

The Soils Engineer shall be notified at least two (2) days prior to the start of grading. A pre-grading conference should be held between the parties involved so as to discuss methods of operation, site problems and scheduling. Field density tests will be made by the Soils Engineer, subject to the approval of all public agencies having jurisdiction. When tests or inspection indicates that the density or uniformity of any portion of the fill is inadequate, that particular portion shall be removed or reworked until the required density has been satisfactorily obtained.

Supervision

At all times the Contractor shall have a responsible field superintendent on the project in full charge of the work with authority to make decisions. He shall cooperate fully with the Soils Engineer in carrying out the work. Any instructions given to him by the Soils Engineer or his duly appointed representative shall be considered to have been given to the Contractor personally.

Rainy Weather

No fill shall be placed, spread or rolled during unfavorable weather.

- B5 -

When the work is interrupted by rain, operations shall not be resumed until field tests by the Soils Engineer indicate that conditions will permit satisfactory results.

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